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Forest Service

Forestry Research West

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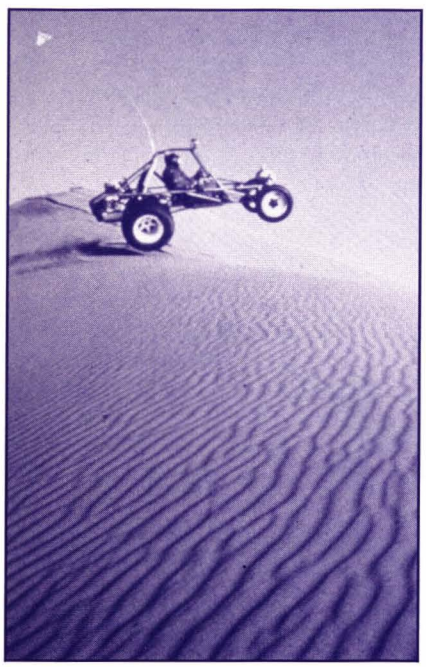

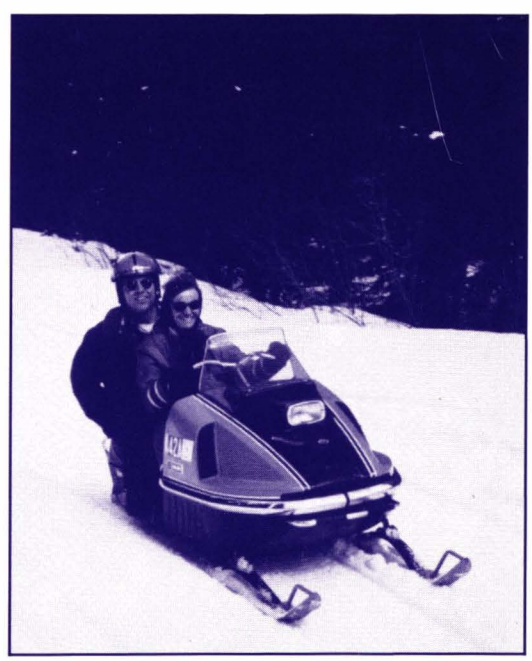

A report for land managers on recent developments in forestry research at the four western Experiment Stations of the Forest Service, U.S. Department of Agriculture.

Forestry Research West

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The term "outdoor recreation" can have a different meaning for different people — from a stroll around the block to a 10-day whitewater rafting excursion. Urban growth, increased aging of the U.S. population, and changing patterns of immigration and racial and ethnic diversity are just some of the factors recreation resource managers are facing as they plan for the future. Forest Service scientists are researching how best to address these changes and meet the needs of outdoor recreationists. This issue of "Forestry Research West" contains two articles on the current and future changes of outdoor recreation. They begin on pages 1 and 8.

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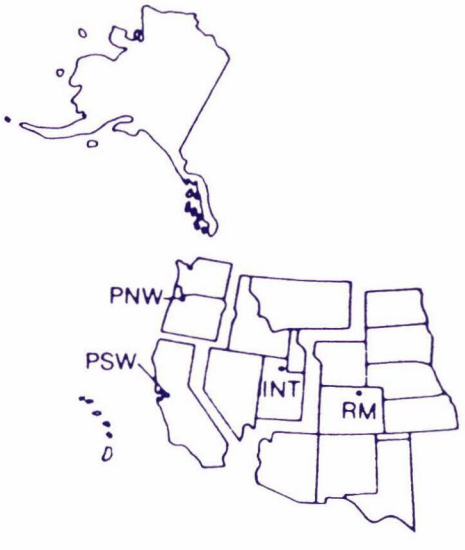

A crystal ball glance at outdoor recreation

by Rick Fletcher
Rocky Mountain Station,
and John Dwyer
North Central Station

Outdoor recreation has been, and continues to be, one of our Nation's favorite pastimes. From backcountry wilderness treks, to simply visiting a local city park, we enjoy getting outdoors. Since much recreation occurs on National Forests, the USDA Forest Service is involved in finding out what people like to do, what they look for in recreation opportunities, and how to better improve services to the public. This is a complex issue, but recreation resource planners and managers are discovering an emerging link between recreation preferences and increases in aging, racial and ethnic diversity, and urban residence.

Forest Service Scientist John Dwyer (North Central Experiment Station, Chicago, IL) says "two main demographic factors have implications for managing recreational resources: 1) increased aging of the population (accompanying slower population growth and longer lifespans — the age is shifting from younger to older); and 2) an increase in visitors from different racial and ethnic groups. Between 1990 and 2025, the U.S. population will increase by 50 million, of whom 17 million will be Hispanic, 14 million African American, and 10 million from other groups. "Minorities will make up over 80 percent of the population increase," he says.

Urban growth is also a factor. The 1980's witnessed a return to the trend of greater increases in metropolitan areas than in non-metropolitan areas, with many of the Nation's largest metro areas seeing growth of 20 percent or more.

Some recreationists enjoy getting away from it all, while others prefer to relax at a local park or lakeshore.

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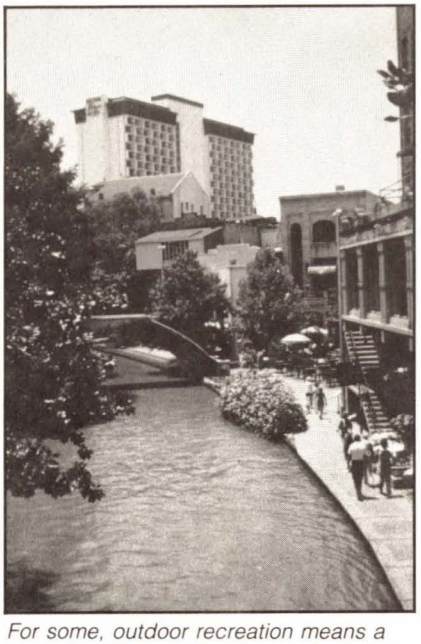
EXPERIMENT STATION

Those who study, plan for, and manage recreation facilities and programs are looking for information about the implications of population changes for the future demands of recreation users. Early recreation research often focused on the connection between recreation activities and demographic variables. "Growing recreation activity was tied to increases in population, income, mobility, and leisure time," says Dwyer. "That work was widely reported and often used to support expansion of outdoor recreation facilities and programs. More recently, however, substantially lower rates of growth in population, income, mobility and leisure time have brought more attention to the increasing diversity of the population and its implications for recreation resource management."

"Identifying the likely change in recreation participation and the associated resource demands that might accompany demographic changes, such as aging, growth in racial and ethnic minorities, and increased urbanization, is a difficult challenge," says Dwyer.

"If you examine the percent of U.S. adults participating in recreation activities at the national, state, regional and local levels, you find distinct patterns that are associated with the current distribution of population with respect to age, race and ethnicity, and urban or rural residence," he says.



For some, outdoor recreation means a simple stroll through an attractive urban environment.

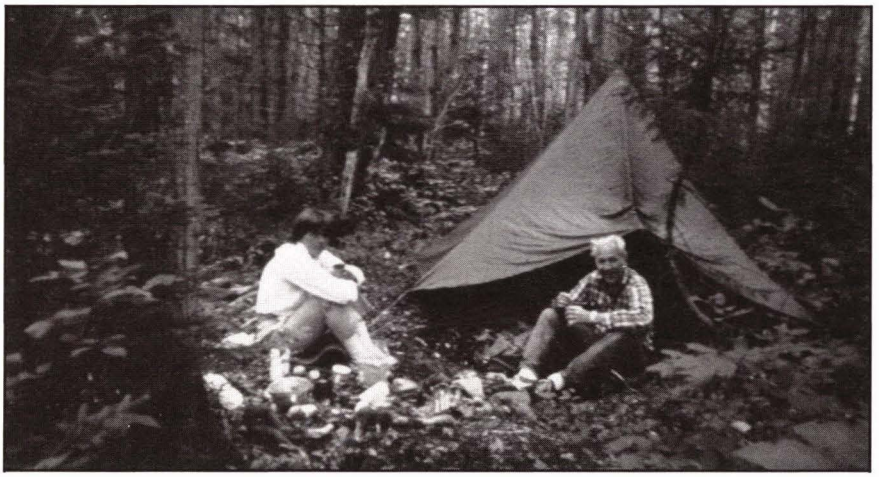
For instance, studies show significant differences in participation across racial and ethnic groups, with significantly lower participation for African Americans in wildland environments, far from urban areas, or involving water, ice or snow. An example — African Americans hike and backpack at one-tenth the rate of whites, but Hispanic Americans and other groups report higher participation rates than whites.

"There also are significant differences in participation across a rural to urban continuum, with participation patterns reflecting the availability of opportunities in these areas, as well as lifestyles," says Dwyer. "For example, there is a higher rate of participation in hunting and fishing in rural areas, and higher participation in activities requiring specialized facilities in urban areas, such as golf and tennis."

Looking ahead

Dwyer and his associates are using the "cohert-component" projection model (first applied to recreation by S. H. Murdock et al.) to help project the implications of demographic changes. "When applied on a national scale, it shows that there will be important future changes in outdoor recreation participation, and in the age and racial and ethnic structure of participants," he says.

Dwyer stresses that one thing is certain — "expect changes." And what might those be? Outdoor recreationists are likely to increase in numbers at a slower rate than in the past, and will be increasingly older, urban, and from racial and ethnic minority groups. It will also be more difficult to predict future outdoor recreation behavior because of societal changes and people's altering preferences.



Preferences vary, from the comfort of developed campgrounds, to "roughing it" in the backcountry.

"These changes will have wide-ranging implications for recreation resource management programs. Consideration will need to be given to major changes in the design and management of recreation settings, signing, the focus of visitor programs, information and marketing, and the selection and training of those who work with visitors," says Dwyer. He notes that particular attention should be given to the management and use of resources in or near urban centers. Increased concentration of the population in these areas (especially minority groups), reduced long-distance travel for all groups, and a tendency for racial and ethnic groups to stay close to home, should provide a "heads-up" for those who manage outdoor recreation areas in or near cities.

Dwyer also suggests that it may be necessary to review fee structures. "With an increasing proportion of participants in the 'older-age' class, and a fairly widespread practice of offering reduced fees to older Americans, we are moving toward a smaller portion of users paying for the use of resources. Also, the selection of staff, and the development of training programs, should address the needs of increasingly diverse customers. This includes increased usage of minority and older American staff. Finally, managers and planners should expand dialogue with their diverse customers, both on-site and off-site, to be certain that management plans and programs are in tune with their needs.

Forest Service Research continues to develop guidelines for plans and programs to help meet the needs of customers who are increasingly older, urban and more racially and ethnically diverse. Additional information on these and related studies are found in the publication *Customer Diversity and the Future Demand for Outdoor Recreation*, General Technical Report RM-252, available from the Rocky Mountain Station. You can contact Research Forester John Dwyer at the North Central Forest Experiment Station, 845 Chicago Ave., Suite 225, Evanston, IL 60202-2357, (708) 866-9311.

D.E.M.O.: a Research/NFS cooperative effort

by James D. White
Gifford Pinchot National Forest, and
Karen Esterholdt
Pacific Northwest Station

Gary Twete, North Umpqua Ranger District, assisting in wildlife surveys at the Diamond Lake Ranger District, Umpqua National Forest. Twete is holding a golden mantled ground squirrel for weighing and marking. Animals are trapped by both ground and tree traps (note trap on side of tree to the left at about head height). (photo by Rick Abbott)

The President's Forest Plan (the recently completed plan for managing National Forests in the range of the northern spotted owl) includes important changes in approaches to managing forests. One, for example, is the component to retain some of the original forest — either in individual trees or in small patches of intact forest — after a regeneration timber harvest. Scientists and managers have concluded that retention of portions of the original forest will be essential in ecosystem management. Yet, despite belief in the importance of retaining these features, there is little information to help foresters determine how much to retain. Is it better to leave individual trees, or to leave intact patches of forest? How many trees or patches are best? In addition, we need to know more about the effects of these practices on specific aspects of the ecosystem. Good information is available for tree growth and regeneration, but what about populations of small mammals, such as northern flying squirrels? Or a multitude of mushrooms, truffles, and other fungi? Or the native plants on the forest floor?

To answer some of these questions, a study has begun on National Forest System and Washington State Department of Natural Resources lands, in association with the Pacific Northwest Research Station and their partners. The Douglas County Project in southern Oregon and the Ecosystems Research Group at the University of Washington were instrumental in supporting the study; they have been joined by Oregon State University and the University of Oregon.

The Demonstration of Ecosystem Management Options, or D.E.M.O., project will evaluate a wide range of silvicultural treatments for managing forest ecosystems, and develop information on a range of management options, all of which seem biologically and operationally feasible, and each of which may have its time and place in managed forest landscapes. The design of D.E.M.O. provides for long-term evaluation of treatments on multiple resources and biological, social, and economic values.

D.E.M.O. design

The D.E.M.O. project will focus on regeneration harvests, and will be installed primarily in mature forest stands. Different methods of regeneration harvest cutting will be examined, all intended to foster the health and productivity of multiple-use forests. The project will focus on species associated

with old-growth of late successional forests (mature forests). A primary focus will be to evaluate green tree retention as prescribed in the President's Forest Plan.

The project will evaluate six treatments that differ primarily in the density and arrangement of remaining trees after an initial regeneration harvest cut. The treatments will create a broad range of environments. They are defined by how much basal area is retained after harvest (basal area is a measurement of the area of a cross section at the base of the tree):

1. 100-percent retention — Uncut, unmanaged "control stand. This treatment will provide a baseline for judging how effective other treatments are in maintaining, re-creating, or accelerating the development of features of the mature forest.

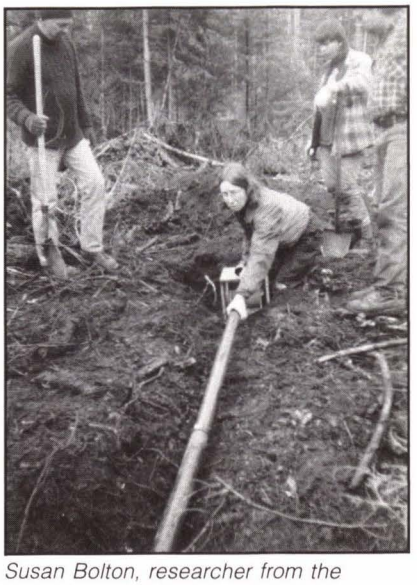
2. 75-percent retention — Initial harvest will occur in small patch cutting of about 1 hectare (2.5 acres). Patches will be dispersed throughout the stand and will occupy about 25 percent of the area. Future regeneration cuttings may occur in 20- to 30-year cycles with some thinnings possibly done at the same time.

3. 40-percent retention (dispersed) — Residual trees will be dispersed throughout the harvested stand and will consist primarily of larger trees. The intent is to provide a test of a moderate level of tree retention, with retained trees dispersed throughout the unit.

4. 40-percent retention (aggregated) — Residual trees will be clumped in patches of about 1 hectare. No cutting will occur within the patches. The intent is to provide an undisturbed reservoir of biological material that may lead to rapid recolonization and recovery of species in the disturbed areas. This treatment is a moderate level of tree retention.

5. 15-percent retention (dispersed) — This treatment is the same as no. 3, above, but with fewer 1-hectare patches retained. This treatment not only provides a comparison with the 40-percent retention treatment, but also is similar to the retention levels called for in the President's Forest Plan.

6. 15-percent retention (aggregated) — This treatment is similar to no. 4, above.



Susan Bolton, researcher from the University of Washington, installing hydrologic testing equipment at the Watson Falls D.E.M.O. block, Diamond Lake Ranger District, Umpqua National Forest. (photo by Mike Amaranthus)

Various silvicultural practices will be used to ensure regeneration and to foster the principal goal of maintaining or accelerating the development of characteristics of the mature forest. Silvicultural practices may be modified to minimize the amount of additional variation they might bring to the study stands. Snags, coarse woody debris, and advanced reproduction will be retained as much as possible.

Basic layout

Treatments will be established in blocks, four in the Umpqua National Forest, three in the Gifford Pinchot National Forest, and one on lands managed by the Washington State Department of Natural Resources. Each block will have one of each of the six treatments. All treatments in a block will be in stands having similar age and species composition, environment, and surrounding landscapes.

The six stands will be at least 13 hectares (32 acres); this minimum size is necessary to assess effects on populations of small mammal and bird species. The stands need to be square to slightly rectangular and surrounded on all sides by a 40-meter buffer. Ideally, the stands should be at least 20 hectares (50 acres), but it is not possible to find enough stands of that size that also will meet other site-selection criteria. Additional constraints limiting available sites are roads, existing harvest units, management allocations, and streamside buffer zones.

Blocks representing a diversity of forest types and stand age classes are being evaluated for use in the D.E.M.O. project. Blocks will be located in the Western Hemlock, Western Hemlock/White Fir, and Pacific Silver Fir Zones; age classes represented will range from about 70 to 300 years or more. Douglas-fir is the predominant tree species in all blocks. The majority of conditions faced by resource managers in forests on the west side of the Cascade Range will be represented; thus, basic findings should have broad applicability. At the same time, the wide range in conditions increased the need to collect adequate data on pretreatment conditions and wildlife populations. For some of the study variables, such as wildlife, 2 years of preharvest baseline data collection are planned. Other less dynamic parts of the ecosystem (vegetation, for example) will be studied for 1 year before the treatments begin.

Major areas of investigation

The D.E.M.O. project provides an opportunity to examine effects of treatments on many ecosystem characteristics and in relation to other management considerations, including public expectations and economics. Because of limited time and financial or human resources, decisions have to be made on which subjects to study. Some high-priority items have been selected in six general subject categories.

Vegetation

Vegetation assessments will include the survival, damage, and growth of residual trees, advanced tree reproduction, and other woody and herbaceous vegetation; "survival" and dynamics (decay) of snags and down trees; and the establishment and growth of tree seedling regeneration.

Wildlife

Wildlife studies will determine population densities and habitat use by several species of small mammals, birds, amphibians, and reptiles. For the most part, D.E.M.O. will focus on wildlife species with home ranges at the stand level. The size of the sampling grid, for instance, was driven by the home range size of the flying squirrel. D.E.M.O. also may provide some information about habitat use by ungulates and other farther ranging mammals and birds.

Soils, fungi, and other special forest products

Work on soils, fungi, and special forest products will evaluate disturbance and compaction of the forest floor and will determine the abundance, community structure, and dynamics of fungi and special forest products. The demand for one special forest product, mushrooms, has greatly increased in the Pacific Northwest during the past few years, which is important both ecologically and economically. Fungi also are critically important components of food webs for wildlife species in mature forests. We know very little, however, about the effect of different management regimes on these organisms.

Observing, identifying, and recording all fungi on a plot at Watson Falls D.E.M.O. site, Diamond Lake Ranger District, Umpqua National Forest. (photo by Rick Abbott)

Hydrology

Hydrologic investigations will focus on quantity and quality of water moving along surface and subsurface flow paths, snow accumulation, rain-on-snow events, and potential impacts on watersheds.

Social perceptions

D.E.M.O. will include investigations of the aesthetic value of each treatment. Perceptions will be categorized by attitudes and policies and in relation to the amount of information people have about management objectives.

Economics

Economic investigations will focus on financial evaluation of harvesting costs, stumpage values, and future stand growth; economic values of residual trees; and a wide range of commodity and noncommodity values.

Supporting studies

The D.E.M.O. installations and the data sets developed from them will provide many opportunities for supporting studies — for example, (1) the relations of original stand characteristics and thinning and harvesting levels to resulting canopy coverage; (2) performance of genetically selected stock in the diverse environments created by different silvicultural practices; (3) depredation of bird nests by corvids (ravens, crows, and jays) and other predators in the different treatments; and (4) effects of treatments on insects, disease, and lichen occurrence and composition. Some of this work may be conducted with D.E.M.O. funds, if resources are sufficient. If not, such studies can be incorporated into an already established network.

For more information

The D.E.M.O. study is being coordinated by a team of scientists and managers from the Pacific Northwest Research Station, the National Forest System, and the Washington Department of Natural Resources. For additional information, contact any of the following:
Mike Amaranthus, Pacific Northwest Research Station based at Siskiyou National Forest, Grants Pass, OR (503) 471-6500; Keith Aubry, Pacific Northwest Research Station, Forestry Sciences Laboratory, Olympia, WA (360) 956-2345; Al Horton, Pacific Northwest Research Station, Portland, OR (503) 321-5800; Brenda Woodard, Umpqua National Forest, Roseburg, OR (503) 672-6601; Jim White, Gifford Pinchot National Forest, Vancouver, WA (206) 750-5000; and Jim Hotvedt, Washington Department of Natural Resources, Olympia, WA (360) 902-1000.

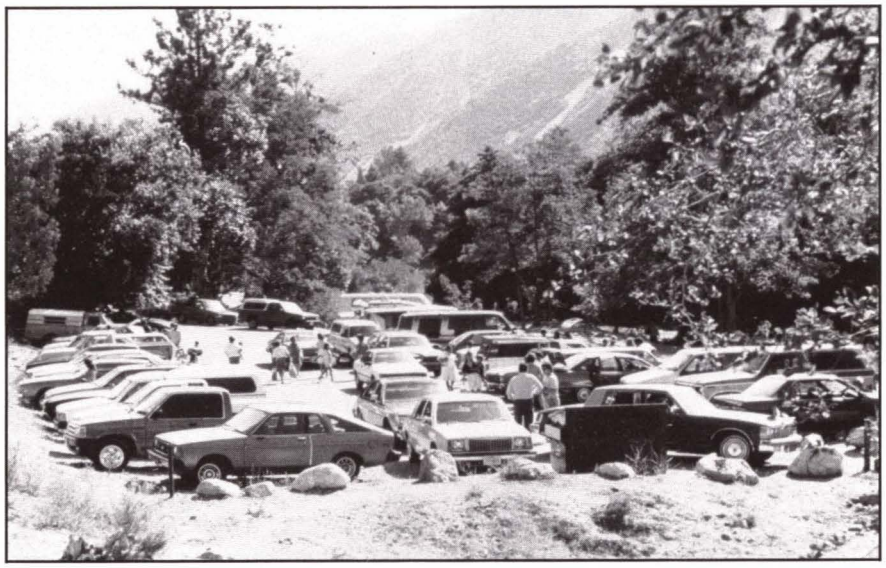
The changing face of wildland recreation

by J. Louise Mastrantonio for Pacific Southwest Station

Until recently, most of the people that visited forests and outdoor recreation areas in the United States were of Anglo-Saxon heritage.

That is changing, however. The reasons? Urban growth and changing patterns of immigration. Urban growth brings more city dwellers, often of diverse ethnic backgrounds, to outdoor recreation areas. In recent years, large numbers of people have come to the United States, principally from Asia, Mexico, and Central America. The changing population patterns, and their effects on wildland recreation, are most apparent in places like Florida, parts of the Pacific Northwest, the Southwestern United States, and southern California.

California is a case in point. In the 1980's, 25 percent of all immigrants to the United States came to California. In 1990, California became the first state so diverse that no single ethnic group comprises 50 percent or more of the population. By 2020, Hispanics could become the nation's largest ethnic group.



Forest managers were seeing dramatic changes in recreation use, including large numbers of people.

Research program

At the Forest Fire Laboratory in Riverside, California, a research facility of the Pacific Southwest Research Station, social scientists are looking at various aspects of ethnic diversity in wildland recreation.

Research began in 1988 as a result of concerns raised by managers of the region's four national forests: the Angeles, Cleveland, Los Padres, and San Bernardino. On these forests, all of which are within a 1–2 hour drive of major metropolitan areas, managers had begun to see dramatic changes in recreation use: large numbers of people, more visitors of different ethnic backgrounds, people taking shorter trips closer to home, larger groups, and people using the out-of-doors in non-traditional ways. Sometimes, managers also saw what they considered to be "depreciative" behavior: littering, vandalism, and other activities that damaged natural resources.

Research goals

Such changes are not necessarily a problem, according to Dr. Patricia Winter, project leader for Wildland Recreation and Urban Culture Research at Riverside. But they do raise many questions for managers . . . questions that can be addressed through research.

The principal goals of the program are to:

- Learn more about the people who use "urban-wildland" areas (their cultural and ethnic diversity, age, socio-economic status, language, education, activity preferences, etc.)
- Look at conflicts between user groups (for example, bikers and equestrians), between visitors and resource managers, and depreciative behaviors (damage to natural resources and facilities).
- Learn more about communication channels: how people find out about recreation areas and how best to communicate with them both on and off the site.

In the natural sciences, new information comes from data gathered from observation in the field or laboratory. In social science research, new information is also the result. But in this case, the subject is people and the new information is specific data about them: where they come from, their ethnic background, characteristics, attitudes, and behavior. Data is gathered through observation, personal interviews, and questionnaires.

Such information can be very helpful. In southern California, managers consider it as important as any other kind of data. In fact, managers have helped set the direction for research, cooperated in studies, and will ultimately be the main users.

People that visit outdoor recreation areas tend to have many things in common. They obviously come to the out-of-doors because they like it and want that experience. They often select a "preferred" site and return again and again. And visitors to a given site may engage in similar activities.

Cultural differences

But in this research, scientists wanted to learn more about the differences between and among user groups. They didn't have to look far. Almost from the beginning, distinct differences were identified in the way people used the sites.

Many studies have pointed out the differences between Hispanic and Anglo users. Hispanics tend to rate certain site characteristics more important than do Anglos: picnic areas, parking, signs, friendly rangers, ease of access, and few rules and regulations. In general, Hispanics tend to put more emphasis on family recreation, prefer more intensively developed sites, passive forms of recreation (picnicking, relaxing, etc.), and have more concern about their personal safety. In contrast, Anglos tend to put highest value on natural beauty, a clean, unlittered environment, and active, goal-oriented activities such as hiking, walking, and riding motorcycles.

Central American users

Consider the way visitors of Central American descent used four recreation areas in the San Bernardino and Angeles National Forests during one study. Their activities were very different from the way Anglos use recreation areas.

Most groups arrived at the recreation site between mid morning and noon. Food preparation was a dominant activity, primarily foods of a traditional nature: carne asada, tortillas, tacos, refried beans, and tamales, or hot peppers and plantains. Most meals were prepared entirely at the site. In one case, a goat was cooked all morning for a group lunch.

Creeks were a focal point of activity for both adults and children. Adults might wade or sit in the water and watch the children playing around them. Later in the day, they socialized, napped, listened to the radio, or played games. Spanish-language broadcasting of baseball or soccer games were popular. Recreation areas were also commonly used as part of a church activity. A group might come by bus after church for a picnic; afterwards the children played games while the adults talked and relaxed.

Many activities considered common for Anglos were not observed. Sunbathing was rare, for example, and few people wore bathing suits even in the water, preferring instead to wear their everyday clothes.

All in all, people tended to use the site the way they had used the outdoors in their native country, in this case, Nicaragua. In effect, they sought to duplicate their past experiences. For these people, coming to the forest was often a "bittersweet" experience, a good time to be shared with family and friends, but also a reminder of the way things used to be back home.

In general, Hispanics put more emphasis on family recreation.

Implications for management

To date, more than 15 studies have been conducted as part of this program, both in cooperation with National Forests, the Bureau of Land Management, other landowners, and cooperating universities. Out of this research has come much useful information. A key finding is that every area is unique. No two areas are used exactly the same way and the visitors to those areas also differ in their cultural heritage, values, and recreational pursuits.

An example is Mecca Hills, a BLM recreation site. There researchers found significant differences in the type of visitors that used the area on holiday versus non-holiday weekends. Throughout most of the year, visitors were mainly Anglo and tended to use the site in rather traditional ways. On holiday weekends, namely Mothers Day and Easter, use was very different: dominantly Hispanic, larger groups devoted to family-oriented activities, and people with a preference for more highly developed facilities.

Research results helped managers plan new developments for the site. Because Hispanic use was high on only two weekends, they decided to make temporary changes for those weekends: bring in portable toilets and trash dispensers rather than develop entire new facilities, and bring in bilingual rangers rather than put up all-new bilingual signs.

"The important thing is not to jump to conclusions about what is going on at a particular site," Winter says. "There have been a lot of surprises in this research." For example, what some might interpret to be anti-social behavior (littering, vandalism, etc.) and lack of concern for the resource, is more likely to be the result of different cultural values, differences in the way people use the site, and facilities that are inadequate for the use they are getting.

General guidelines

It is clear times are changing. "The non-traditional is becoming more traditional and the perception of who is a traditional visitor has to change as well," she says. "The important thing is to know who visitors are and develop the skills to communicate with them."

In that regard, there are specific things managers can do to ease the transition:

- Learn how to incorporate the cultural values of non-traditional groups into management plans.

- Develop training programs for staff that have direct contact with recreation users. Field employees should be from culturally diverse groups and/or bilingual, be sensitive to cultural differences, and have more interaction with forest visitors that is not related to law enforcement.

- Increase the use of informal communication channels to reach Hispanics and use whatever language is necessary for signing and interpretive programs.

- Plan water and sanitation facilities with the idea that many users will prepare food at the sites.

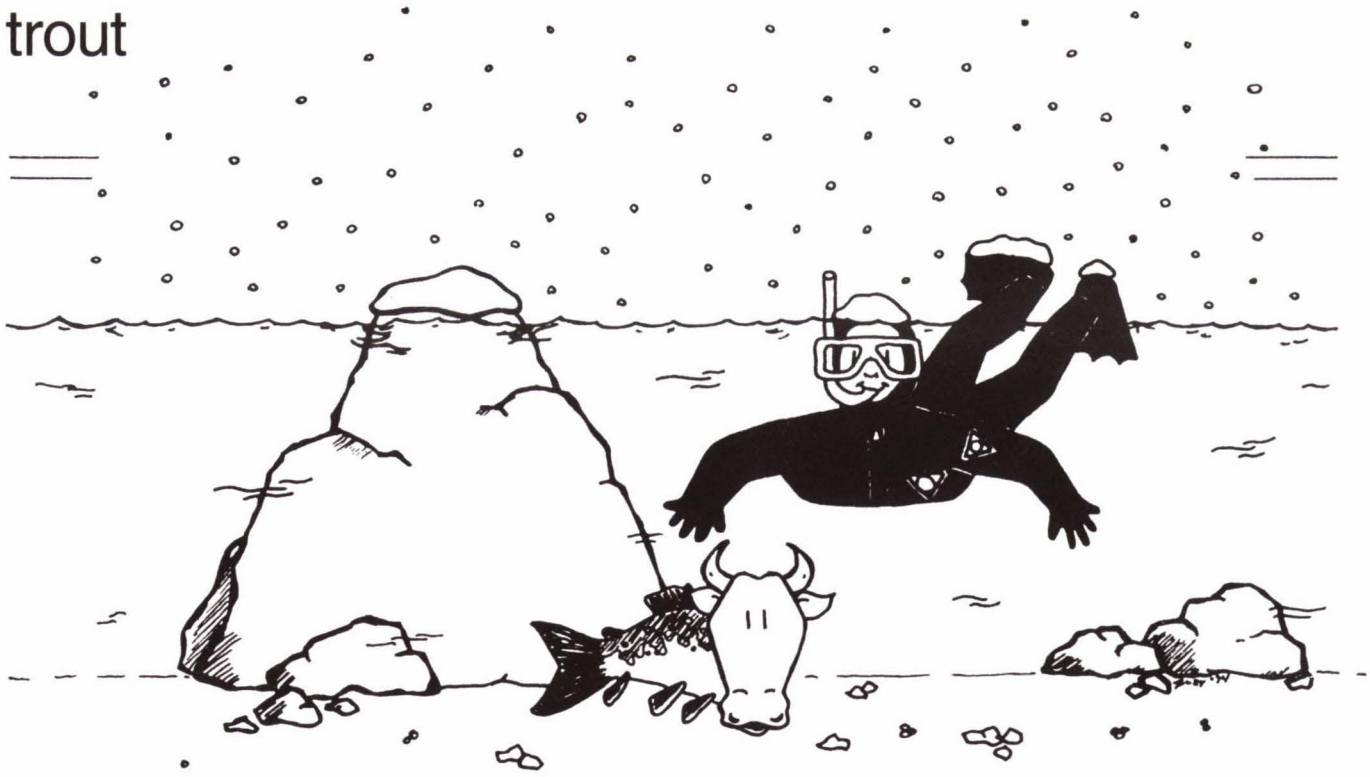
- Use recreationists as volunteers. Because people were often found in "favorite" places to which they have a strong emotional attachment, they may be willing to help out by participating in litter control or education programs.

"We appreciate the opportunity to work closely with managers," Winter ways. "Our job is to provide information about forest visitors and how they are using sites. In the final analysis, however, it is the manager that must make the decisions about what use is appropriate for a particular area.

For further information, contact the Pacific Southwest Research Station and request *Visitor Perceptions of Crowding and Discrimination at Two National Forests in Southern California,* Research Paper PSW-216.

Researchers track the bull trout

by Cindy Chojnacky
Intermountain Station



The status of bull trout is of growing concern to the Forest Service and other land management agencies in the Intermountain West. In June 1994, the U.S. Fish and Wildlife Service determined that listing of bull trout was "warranted but precluded" under the Endangered Species Act. The Forest Service considers this native fish a "sensitive" species — at risk and a candidate species for further protection. Yet little is known about bull trout distribution, abundance, and habitat needs.

Russ Thurow, and other researchers at the Enhancing Fish Habitats Project in Boise are out to change that. They are using radio telemetry, underwater surveys, and stream mapping to understand the critical habitat needs and seasonal habitat uses of bull trout.

Unlike anadromous fish such as the chinook salmon, the bull trout spends its entire life cycle in freshwater — there is no great pilgrimage to the ocean and back. However, it does get around. Fluvial stocks of bull trout spawn in small stream reaches, move down to larger rivers to winter, and migrate upstream to their home streams to spawn again.

Belly down in icy water

In a joint venture with the Idaho Fish and Game Department, Thurow is tracing the journey of bull trout that spawn and rear in a tributary of the Salmon River, then move down to the main river to overwinter in pools. Thurow has spent many long frigid winter hours belly down in icy water learning where bull trout winter.

His experience in observing trout underwater resulted in the recent publication of *Underwater Methods for Study of Salmonids in the Intermountain West,* General Technical Report INT-307.

The interagency research team includes Thurow, Biologist John Guzevich, and Fish and Game's Dan Schill and Steve Elle. The project began in 1992, and a third field season is being completed. "It's a good partnership," noted Thurow. "We have pooled equipment, people, and expertise. We have collected a lot more information by sharing resources and personnel."

Goals of the study are to (1) describe bull trout seasonal habitat uses and critical habitats;

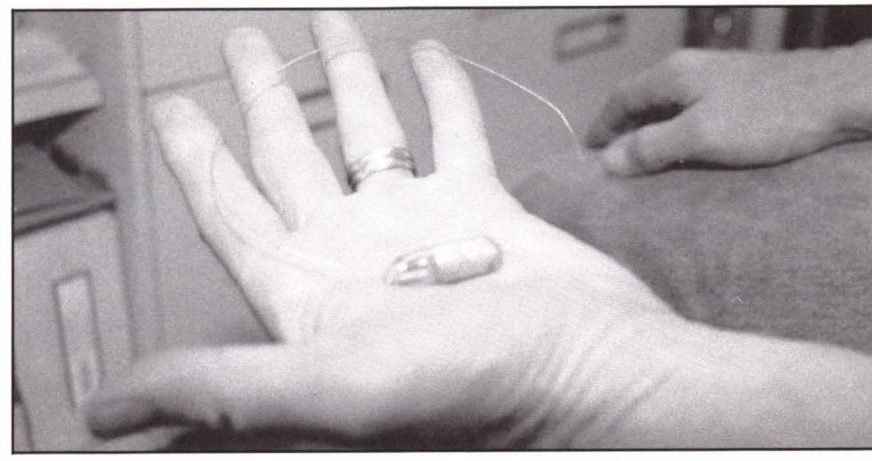
(2) evaluate bull trout dispersal and "homing" — where juveniles migrate to rear, and whether adults show "fidelity" by returning to the same area to spawn; and (3) describe what factors influence fish movements and when fish move.

First, "we collect information on all fluvial bull trout that enter the stream" through a Department of Fish and Game fish trap. Next, the team surgically implants radio tags in the abdomen of a subsample of bull trout. "We've taken care to properly learn the surgical technique," Thurow said. The tags are selected so they weigh less than 2 percent of fishes bodyweight.

No mortality after surgery

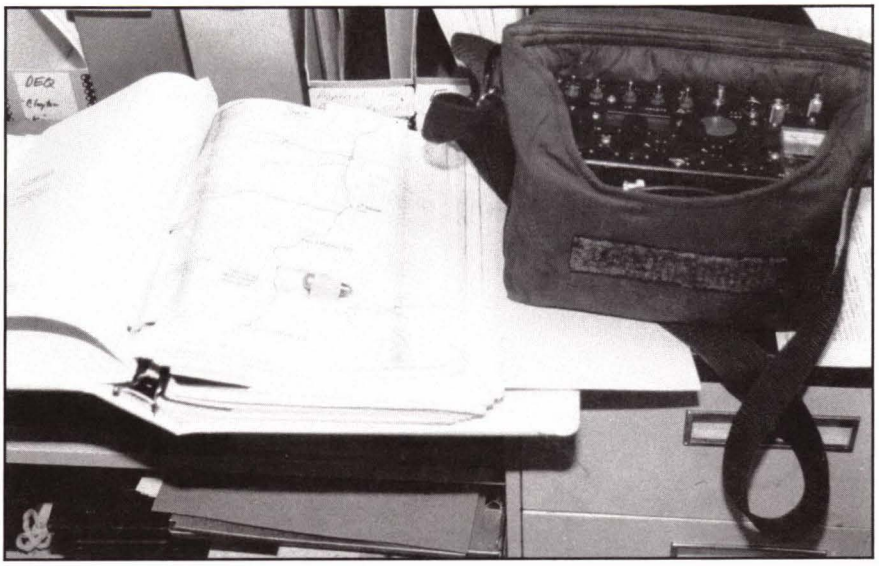
The team was trained in the surgical technique by experienced personnel, watched videos of surgery, and practiced on hatchery trout before attempting the surgery on bull trout. "Our training paid off, said Thurow. "We have observed no mortality of wild bull trout for the first two months after surgery."

The implanted fish are returned to the stream and tracked using radio telemetry. Each tag emits a unique signal for 220 days to one year.



Radio tag which is surgically implanted in bull trout.

Bull trout anesthetized and ready for surgical implant.



Equipment used for bull trout tracking: tag, receiver and book of topographic maps for plotting trout locations.

Several days after fish are released, an aerial survey is conducted with an experienced pilot who flies down the creek's 20-mile length with radio equipment on board. A receiver picks up tag signals so that a fish can be located within several hundred meters of its true location. Fish locations are marked on a topographic map of the watershed.

Next, researchers walk the stream, using the marked topographic map, wearing headphones and carrying a radio receiver to pinpoint each tagged fish's exact location. When fish are found, their location is described in detail.

Habitat is classified, and stream depth, overhead cover, submerged cover, water temperature, woody debris, and other characteristics are measured. "We're trying to find out whether fish are selecting specific channel features and locations or are randomly picking sites," Thurow explained.

As the bull trout puzzle is put together, the team is linking the location and type of habitat the trout seek with different phases in its life history: prespawning or movements of fish prior to spawning, spawning and construction of redds (locations where eggs are deposited in gravel of stream reaches), and postspawning or when trout migrate downstream and overwinter in the larger streams.

"We can evaluate habitat selection by comparing what habitat is available to what's actually used by the trout," Thurow added. The study is being related to broader habitat inventory work being conducted through Kerry Overton, the project's technology transfer specialist, and National Forest fisheries biologists.

The migratory bull trout's nomadic journey runs something like this: Fish begin moving into the drainage from the main Salmon River in May or June. Their upstream migration coincides with increases in water temperature and stream flow. Through July and August, the fish continue moving upstream toward their spawning area.

Spawn under cover

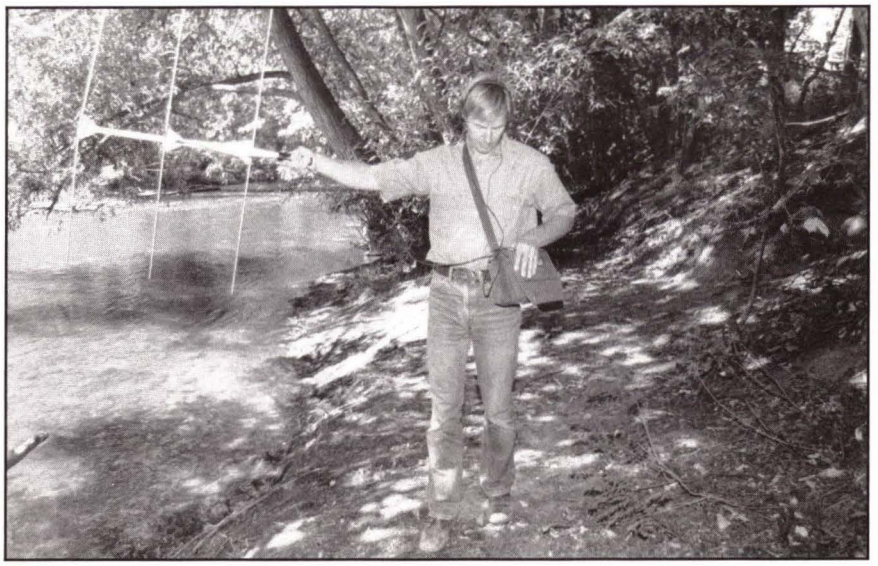
Bull trout spawn from late August to mid-September. "So far we have observed fairly discreet spawning areas. Fish are spawning in specific sites clustered in a few locations." A number of fish have spawned twice and have shown very strong "site fidelity" by spawning within 200 meters of the same location in successive years. Bull trout also seem to have a preference for spawning in areas with overhead cover.

After spawning, fish rapidly move out into the Salmon River and overwinter in large, deep areas. Bull trout remain in the main river from late fall through March and April with very little movement until the following spring.

The researchers have also observed a downstream migration of juvenile bull trout from the tributary in fall. The immature fish have been too small to track with radios so their destination is currently unknown.

During the next phase of the research, biologists will work with physical scientists (geomorphologists and hydrologists), and attempt to link watershed features to the location of critical habitats. "Ultimately we want to evaluate the linkages between larger scale watershed features such as climate, geology, landtype, and elevation and watershed processes such as natural and human caused disturbance with the location of critical habitats for fish," Thurow added. "This will help determine not only what fish need and where critical areas are likely to be found, but it may also help us assess the sensitivity of these critical habitats to disturbance."

After the current research is completed, the researchers will test their ability to predict the location of critical habitats in other streams.



INT Boise fisheries researcher Russ Thurow demonstrates use of radio telemetry equipment to pick up signals from radio tag.

Thurow said the Enhancing Fish Habitats unit in Boise has specialized in studying habitat needs and factors influencing the viability of native fish populations. "Virtually all of our native trout and salmon are currently considered threatened, endangered, or of special status. We recognize that by increasing our understanding of the species and their requirements, we can help efforts to ensure that unique species like bull trout persist," said Thurow.

Two of Thurow's partners in the Boise lab, Research Fisheries Biologist Bruce Rieman and former Project Leader John McIntyre compiled most of what's known about bull trout in *Demographic and Habitat Requirements for Conservation of Bull Trout,* General Technical Report INT-302.

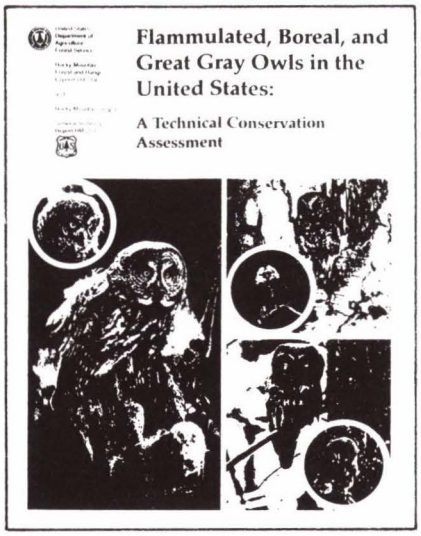
New from research

An assessment of three owls in the U.S.

Scientific knowledge of flammulated, boreal, and great gray owls in the United States is scarce. To help fill the void, scientists at the Rocky Mountain Station have published a limited edition report on the status of these three owl species.

The book, complete with three poster size maps of the US depicting location of species, offers forest managers, research biologists, and the public a thorough discussion of conservation, biology, and the ecology of these forest owls.

Flammulated, boreal, and great gray owls have been designated as "sensitive species" in several regions of the Forest Service. "Sensitive species" are plants and animals whose population viability is identified as a concern by a regional forest. Sensitive species require special management, so knowledge of their biology and ecology is critical.



For a copy of *Flammulated, Boreal, and Great Gray Owls in the United States: A Technical Conservation Assessment,* General Technical Report RM-253, contact the Rocky Mountain Station.

Effects of repeated manual release studied in young plantations

"As we move toward forest ecosystem management, the need for knowledge on plant communities that develop naturally or after a deliberate manipulation will be become increasingly important.

Manipulation could be for a variety of reasons: to create a future forest, to provide an economic crop, to grow plants whose seeds would be critical to wildlife, or simply to provide more diversity and thus be in a position to capitalize on values and commodities that might be needed in the future. In this study, for example, a wildfire had left the plant community with no conifer trees, even though one species (Douglas-fir) was part of the climax vegetation. Planting Douglas-fir seedlings restored the natural community and promulgated a mixture of species.

But, in order for Douglas-fir seedlings to have a chance to become established, the existing shrub and hardwood community had to be treated to free site resources for seedlings. Competition was intense. Manual release, a combination of chain sawing and grubbing, was employed to release the conifer seedlings. Five years after release, Douglas-fir seedlings in treatment R2X (released three times) had significantly larger stem diameters and foliar cover than counterparts in the control. After 5 years, Douglas-fir seedlings were the tallest vegetation (4.7 feet) on treated plots, with fast developing crowns and low mortality."

For further information, contact Pacific Southwest Research Station and request Research Paper PSW-221, by P. M. McDonald, Fiddler and Harrison.

Fish habitat inventory: grazed and ungrazed

Many fisheries biologists believe that improving grazing management along mountain streams in the Intermountain West has potential to improve trout habitat more than any other management activity. Yet, there is frequent debate about the condition of stream communities and how to scientifically monitor the changes that occur with better range management. Fisheries biologists evaluated the differences between rested and grazed stream reaches on Silver King Creek on the Toiyabe National Forest, and tested monitoring methods.

The biologists recommend that managers plan effective monitoring schemes as they plan the stream recovery strategy. The monitoring strategy should evaluate bank stability and channel morphology. Based on inventory data as a baseline, habitat variables to monitor include percent bank stability and undercut, width-to-depth ratios, and pool frequencies and dimensions. Sample sizes need to be large enough to account for differences in habitat types.

The Silver King Creek study reinforced the value of having permanent photo points at the same sites where physical data are collected to visually display changes over time. In addition, new technologies such as Global Positioning System (GPS) and Geographic Information Systems (GIS) will help monitor changes over long time periods when personnel changes.

Request *Northern/Intermountain Regions' Fish Habitat Inventory: Grazed, Rested, and Ungrazed Reference Stream Reaches, Silver King Creek, California,* General Technical Report INT-311, from the Intermountain Research Station.

Sustainability and woody debris

Coarse woody debris is critical to sustaining functioning ecosystems in the Rocky Mountains. Forest ecosystems in the Rockies have great diversity with each habitat type developing and retaining different amounts of debris. This debris has functions ranging from soil protection to wildlife and microbial habitat. The importance of microbial habitat in sustaining forests is becoming better understood and appreciated.

Scientists have studied ectomycorrhizae as a bioindicator of healthy, productive forest soils. From this research they have developed management recommendations for how much coarse woody debris should be kept in a variety of habitat types in Idaho, Montana, and Arizona. These recommendations will help forest managers maintain long-term forest productivity.

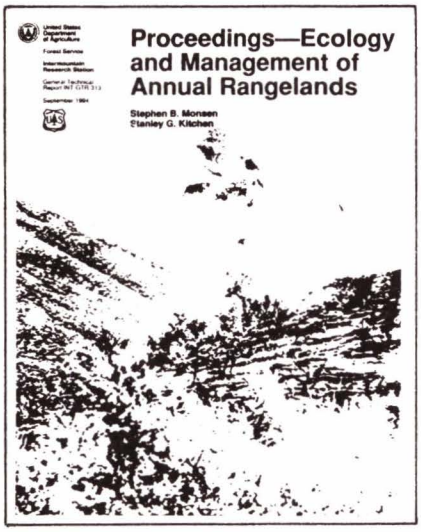
Request *Managing Coarse Woody Debris in Forests of the Rocky Mountains,* Research Paper INT-477, from the Intermountain Research Station.

Studying atmospheric deposition on high-elevation ecosystems

An extensive report on the effects of air pollution on alpine and subalpine ecosystems has just been released. The document provides a description of research conducted at the Glacier Lakes Ecosystem Experiment Site in southern Wyoming, and contains preliminary data on the biological, physical, and chemical environment.

The site was established under the Wilderness Act to study the effects of atmospheric deposition on alpine and subalpine ecosystems. Descriptions of vegetation, geology, soils, aquatics, meteorology, air quality, and snow for the Lost Lake, East Glacier Lake, and West Glacier Lake watersheds are presented. The book also comes with detailed topographic maps on vegetation, geology, and soils. Copies of *The Glacier Lakes Ecosystem Experiments Site*, General Technical Report RM-249, are available from the Rocky Mountain Station.

Ecology and management of annual rangelands



Plant communities around the world are destabilizing and evolving faster than any period in geologic history, due largely to the introduction of exotic species into new environments where they are better adapted to the environment than the native species. Many of the exotics are classified with legal designation as noxious weeds, such as leafy spurge and many of the *Centaurea* species, and are targeted for control. Many other exotics are so well established and so well distributed that they are considered "naturalized" and are expected to remain a component of plant communities.

For example, cheatgrass now occupies over 41 million hectares. Cheatgrass is so well distributed in the arid West that it readily invades a high percentage of disturbed rangeland. Perhaps no exotic species has demonstrated its power to alter an ecosystem more than has cheatgrass, which has dramatically reduced biodiversity and increased the frequency of wildfire over vast expanses.

Range scientists and natural resource managers met in Boise, ID, in 1992 for a symposium on the ecology and management of cheatgrass and the other annuals that are permanently altering rangeland ecosystems. The 416-page proceedings from that symposium is a good compilation of knowledge about this segment of global change.

Request *Proceedings — Ecology and Management of Annual Rangelands,* General Technical Report INT-313, from the Intermountain Research Station.

A guide to research natural areas in five western states

Forest Service Research Natural Areas provide a permanently protected area for the purpose of maintaining biological diversity, conducting research, monitoring and fostering education. A new publication, titled *Research Natural Areas in Colorado, Nebraska, North Dakota, South Dakota, and Parts of Wyoming,* is a guide to these RNAs.

The publication describes the location, significant features, climate, flora, fauna, and published research for the 16 RNA's established through 1993 on Public Lands administered by the USDA Forest Service in Colorado, Wyoming, Nebraska, and North and South Dakota.

For more information, request General Technical Report RM-251, from the Rocky Mountain Station.

To order any of the publications listed in this issue of *Forestry Research West*, use the order cards below. All cards require postage. Please remember to use your Zip Code on the return address.

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3) *Managing Coarse Woody Debris in Forests of the Rocky Mountains*, Research Paper INT-477.
4) *Ecology and Management of Annual Rangelands*, General Technical Report INT-313.
5) *Sixty Years of Change in Tree Numbers and Basal Area in Central Utah Aspen Stands*, Research Paper INT-478.
6) *Northern/Intermountain Regions' Fish Habitat Inventory: Grazed, Rested, and Ungrazed Reference Stream Reaches, Silver King Creek, California*, General Technical Report INT-311.
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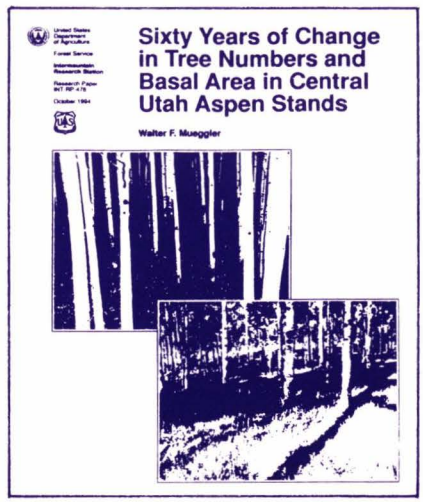
Aspen change in central Utah

In 1913 a young forester named F. S. Baker started investigating the silvics of aspen on the Wasatch Plateau in the then newly created Utah Experiment Station in the Manti National Forest. By 1918 C. F. Korstian was collecting data on the plots Baker established. Baker and Korstian both went on to write silviculture textbooks and become the deans of forestry schools. Between 1913 and 1977 the same aspen stands were measured regularly by a wide variety of respected scientists. Finally, after 64 years of study by at least 15 researchers, retired scientist Walt Mueggler completed the data summaries, interpreted the results, and prepared a manuscript.



The data indicated: (1) stem numbers declined continuously as the stands aged; (2) an inverse relationship existed between aspen site quality and stem numbers in middle-age stands; (3) basal area peaked sometime around 80 years of age and declined appreciably by age 100; (4) greatest mortality in middle-age stands was in smaller diameter class stems; (5) stands thinned between ages 40 and 70 contained more, but smaller, stems at maturity, and greater total basal area than those not thinned.

So, what have we learned from one of the oldest aspen studies by some of the country's most noted silviculturists? These aspen stands defied the traditional wisdom that thinning will increase diameter growth to favor sawtimber or veneer logs. However, thinning favors the survival of more aspen stems and more total basal area.

To thin or not to thin; that is the question. If land managers have their objectives clearly defined the information in this publication can help them make decisions to accomplish those objectives.

Request *Sixty Years of Change in Tree Numbers and Basal Area in Central Utah Aspen Stands,* Research paper INT-478, from the Intermountain Research Station.

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